✦ CONTEXT

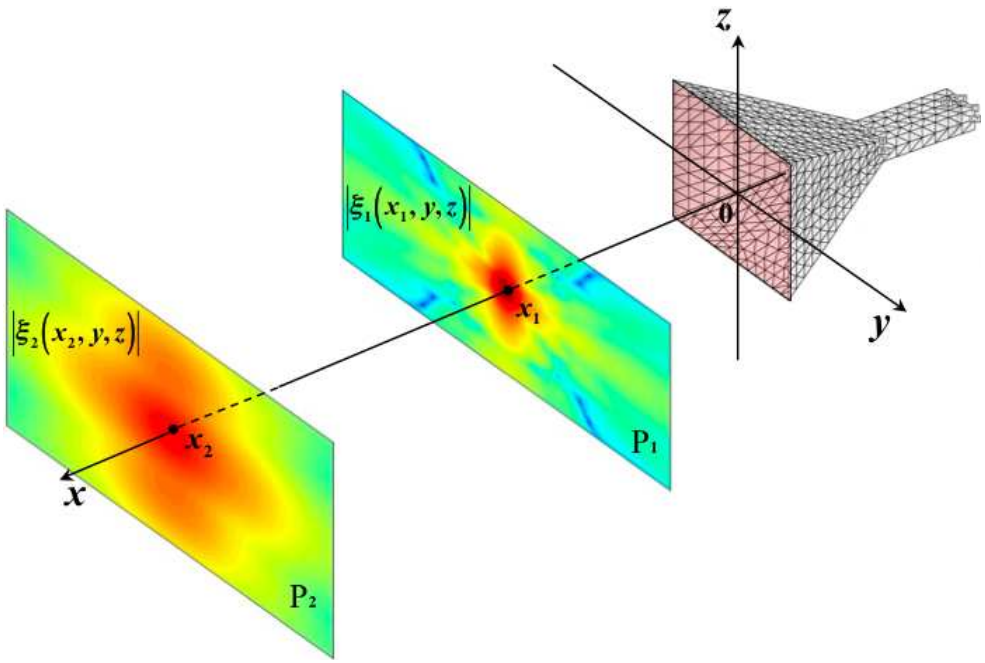
- ✓ **Final purpose**
  - Experimental antenna far field pattern characterization
  - Wide frequency range
  - Pulsed sources
- ✓ **Measurement constraints**
  - Planar near field test setup
  - Magnitude only measurements

✦ APPROACH

- ✓ **Implementation of a phase retrieval algorithm**
- ✓ **Assumptions on sources**
  - CW
  - High directivity

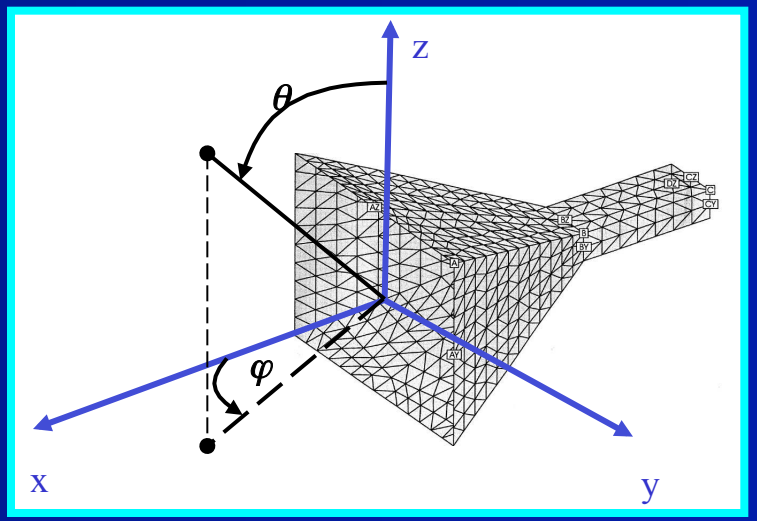
THE PHASE RETRIVAL TECHNIQUE

- **HISTORICAL BACKGROUND**
  - ✓ Gerschberg-Saxton [1972] : electron microscopy (1 plane)
  - ✓ « Misell » variant [1973] : electron microscopy (2 defocused planes)
  - ✓ Anderson & Ali [1984] : microwave applications
- **PRINCIPLE**
  - ✓ Algorithm initialization :
    - Electric field magnitude known in two planes P_1 & P_2 in front of the source



NUMERICAL ASSESMENTS (1/8)

- **Models**
  - ✓ **MoM (Feko)**
  - ✓ **Classical horn antenna (same used for experimental approach)**
  - ✓ **Frequency: 8 GHz**
- **Purposes**
  - ✓ **Validation tool**
    - Agreement Models/Measurements
    - Exact phase calculation
    - Exact far field calculation
  - ✓ **Sets of data for parametric study**
    - $d_{\text{Plane-source}}$ and $d_{\text{plane-plane}}$
    - Planes sampling
    - Planes sizes



✦ Parametric Study

✓ Criterion

$$\Delta_n^{cmplx} = \frac{\sum_{i=1}^{N_y}\sum_{j=1}^{N_z}\left\| E_n(x_1, y_i, z_j) - \xi_n(x_1, y_i, z_j)\right\|^2}{\sum_{i=1}^{N_y}\sum_{j=1}^{N_z}\left\| \xi_n(x_1, y_i, z_j)\right\|^2}$$

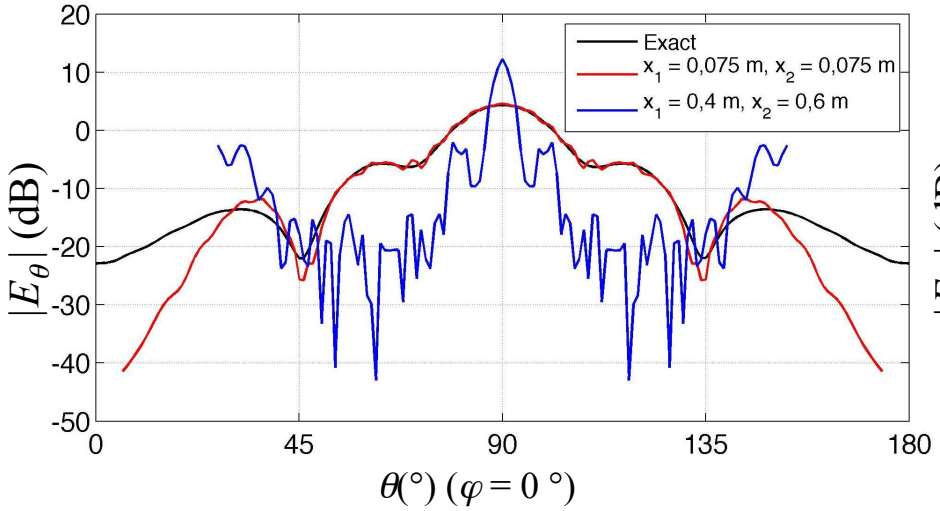
✓ planes positions

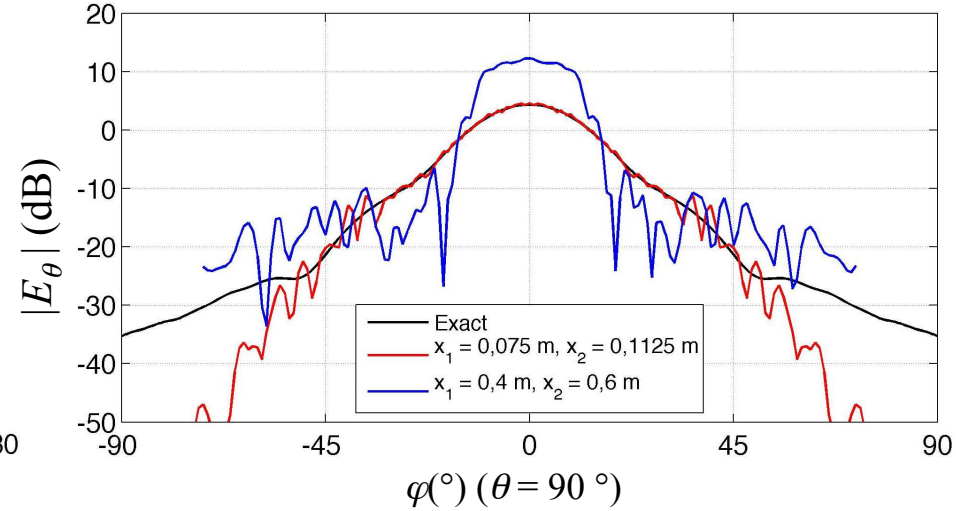
- Fields calculated in magnitude and phase using Feko
- distances : 11 values [$x_1 = 2\lambda$, …, $x_{11} = 1$ m]
- 55 phase reconstructions

✦ Planes positions parameter : x_1 and x_2

✓ Far field from using the reconstructed phase

- Worst case : $\Delta_n^{cmplx} = 222.54\ \%$
- Best case : $\Delta_n^{cmplx} = 7.94\ \%$

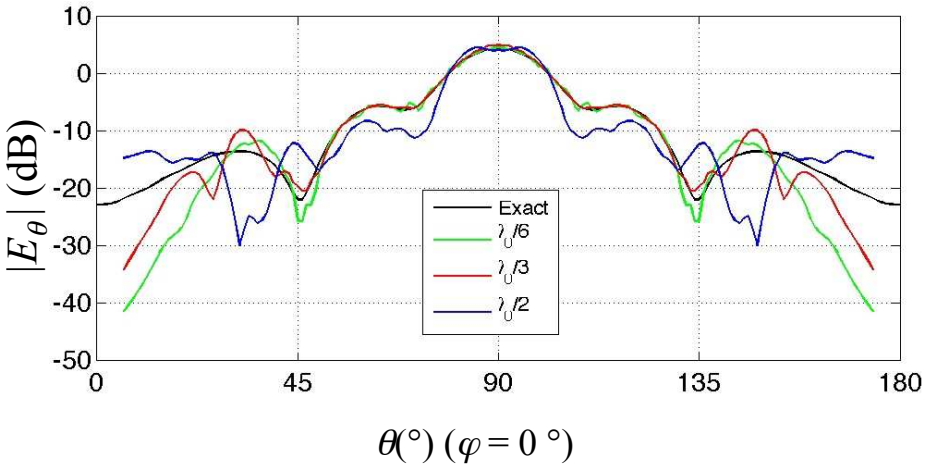


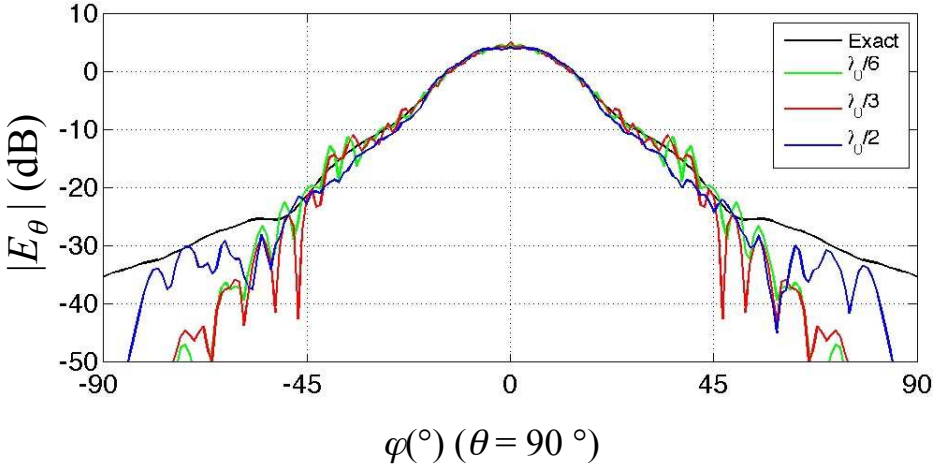


✦ Sampling parameter : δ_x

✓ Far field from using the reconstructed phase

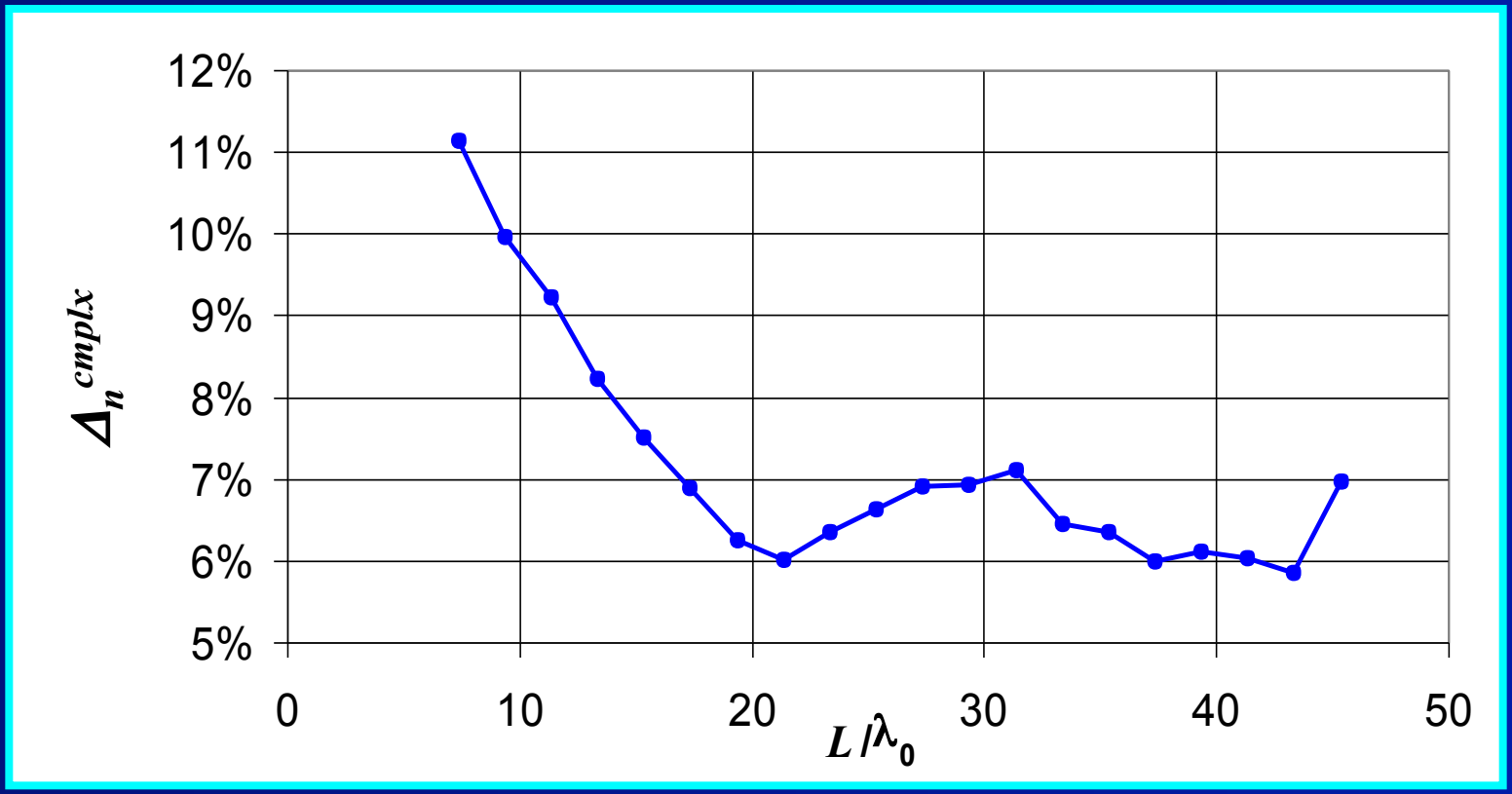
- $\delta_x = \lambda_0/6 \quad \Delta_n^{cmplx} = 7.94\ \%$
- $\delta_x = \lambda_0/3 \quad \Delta_n^{cmplx} = 6.07\ \%$
- $\delta_x = \lambda_0/2 \quad \Delta_n^{cmplx} = 29.53\ \%$





✦Planes dimensions parameter : L

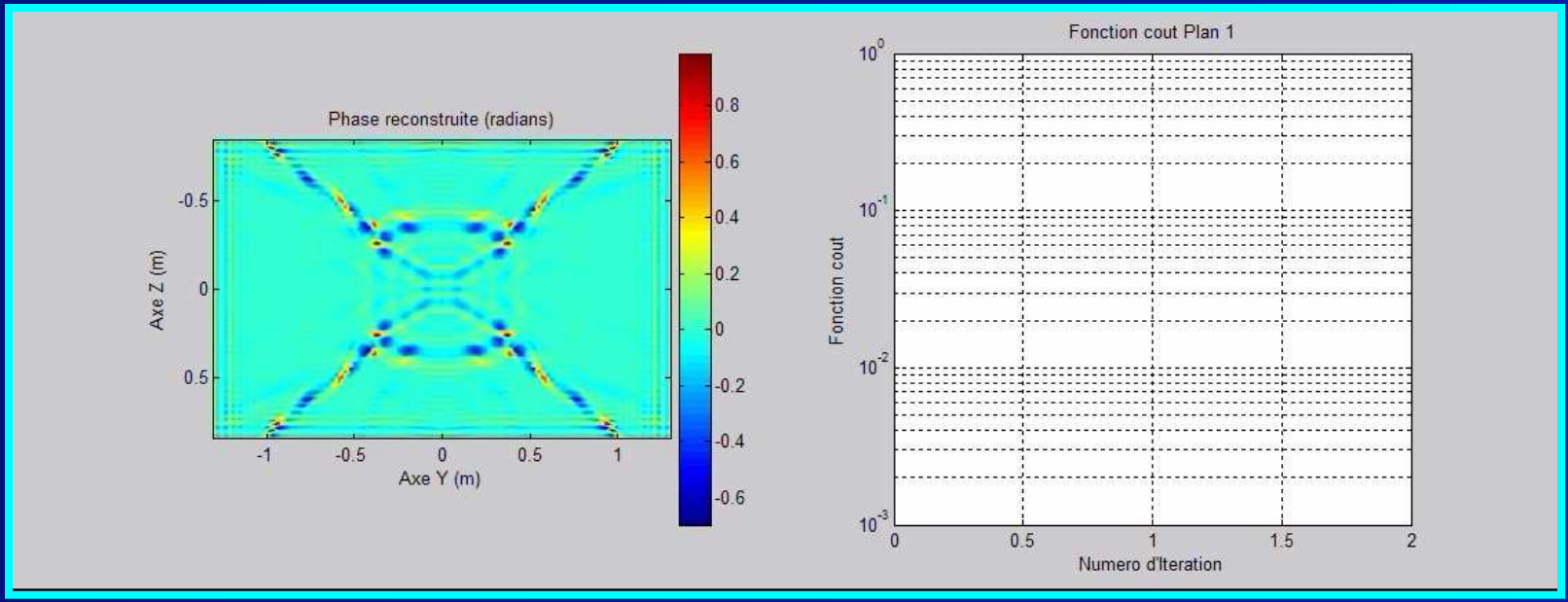
✓ $L_{min} = 20\lambda_0$



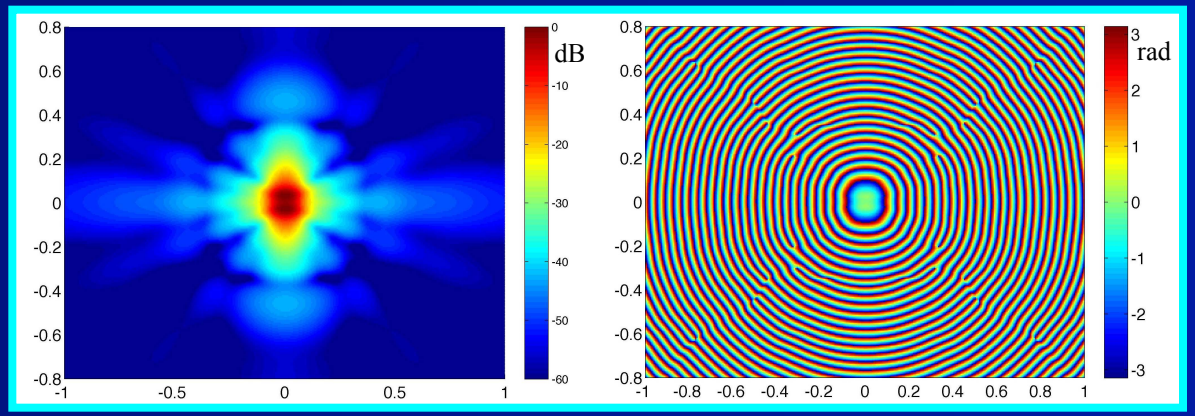
NUMERICAL ASSESMENTS (6/8)

✦Phase reconstructions

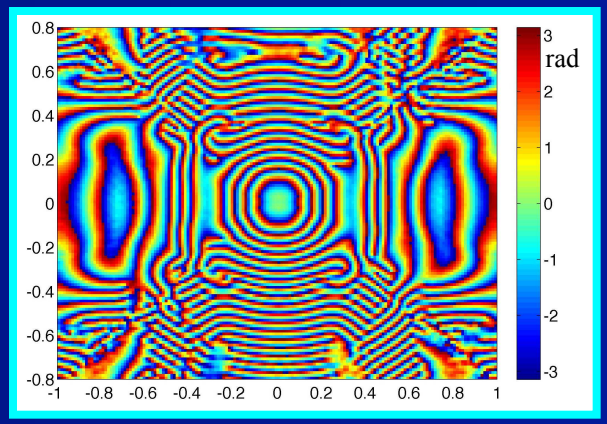
- ✓ ~1000 to 10000 iterations
- ✓ Less than 1 or 2 hours on a standard PC



✦Results at 8 GHz : phase on the first plane

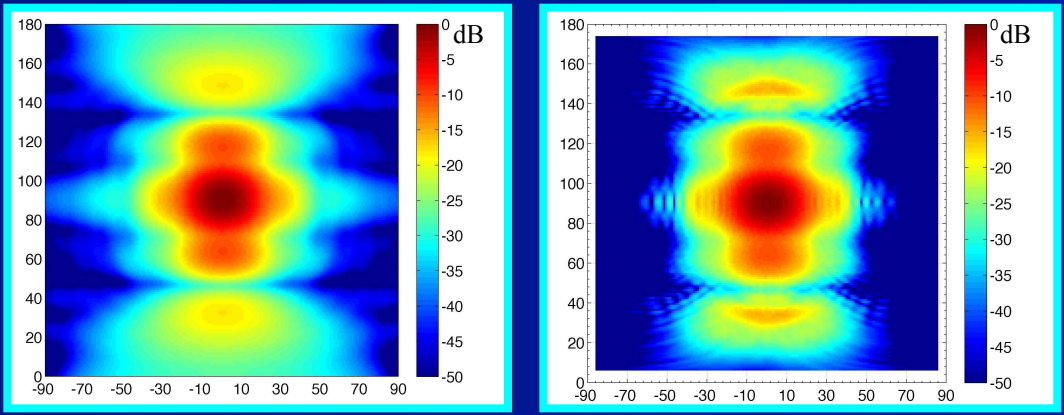


Exact Field, $d = 2\lambda$, magnitude and phase (FEKO) and reconstructed phase

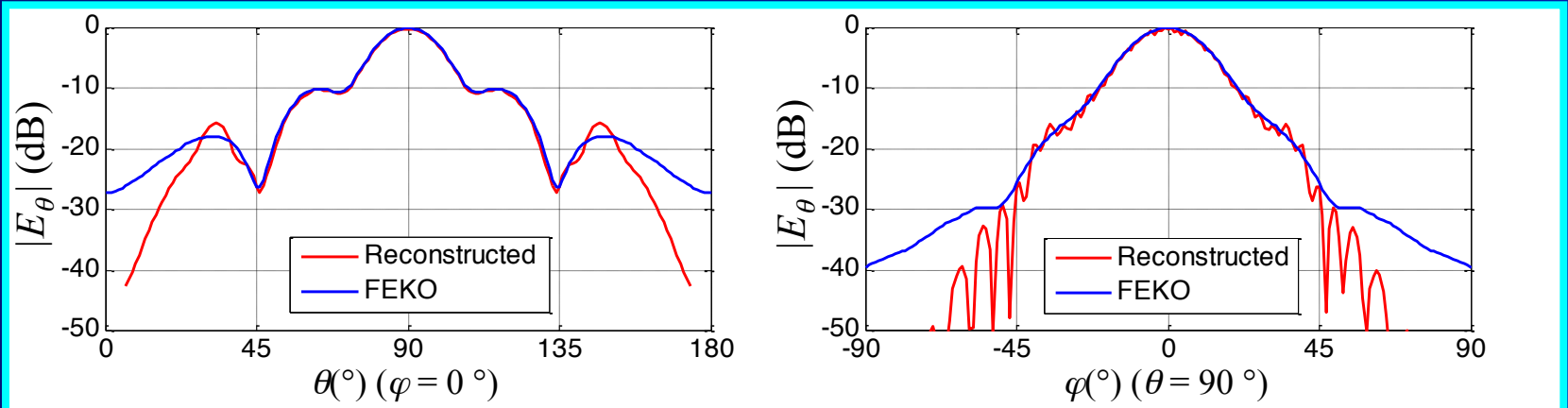


Reconstructed phase

✦Results at 8 GHz : reconstructed far field

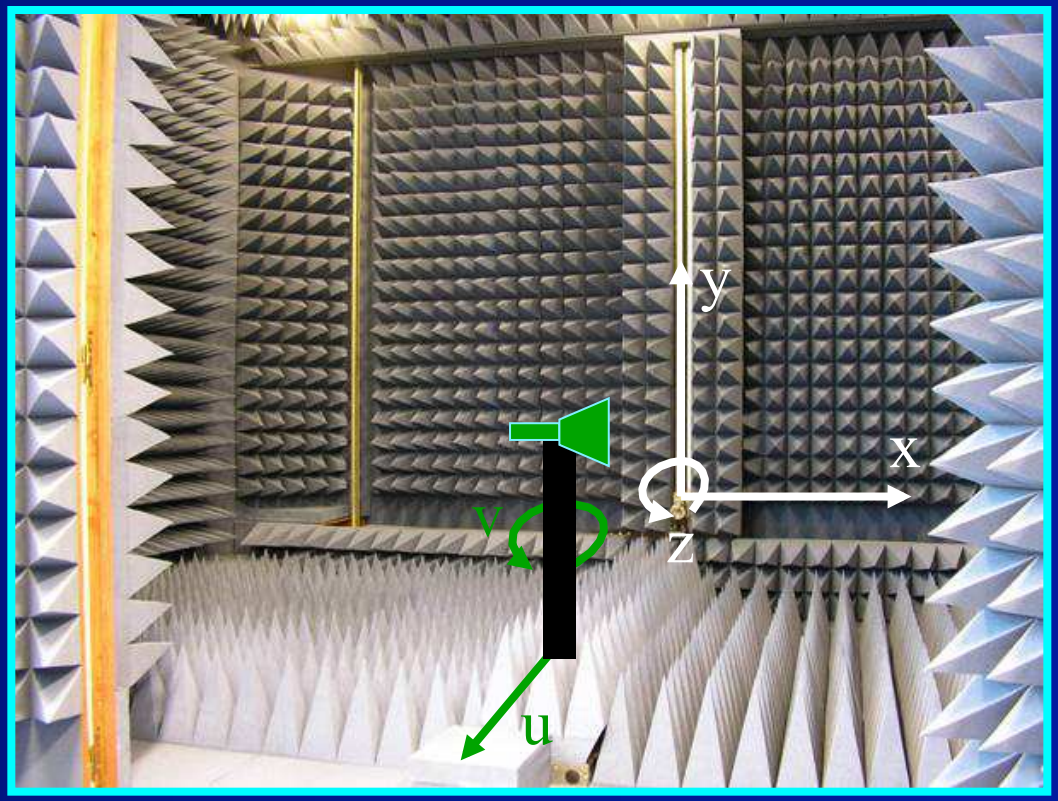


Exact and reconstructed far field



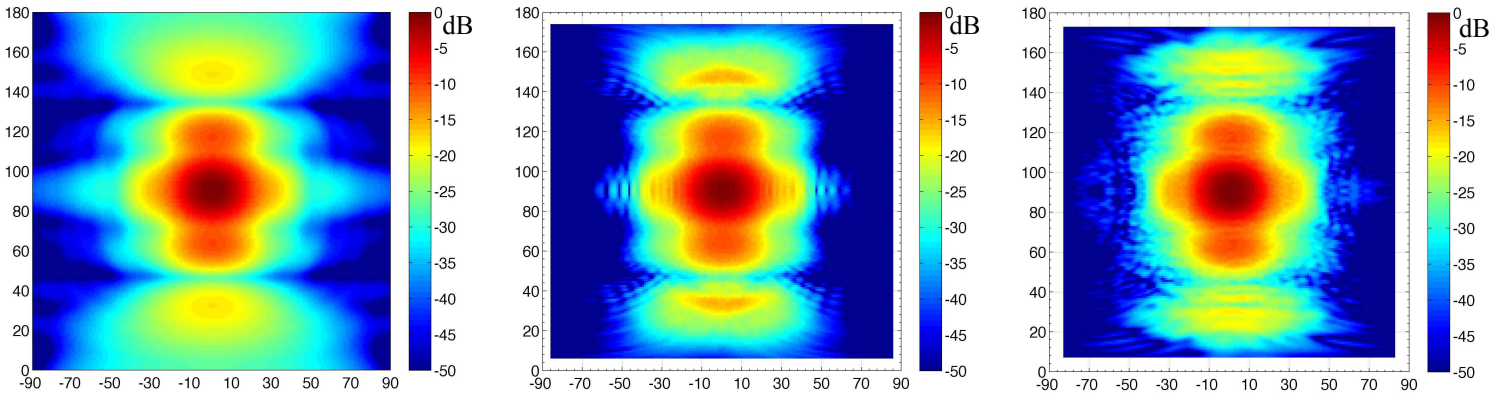
EXPERIMENTAL APPROACH

- **Experimental validation : planar near field measurement setup**
  - ✓ **AUT = Horn, Probe = Dipole, open end waveguide**
  - ✓ **Frequencies = 2 GHz, 8 GHz and 18 GHz**
  - ✓ **Distance AUT/Probe : 2λ, 3λ, … 1m**

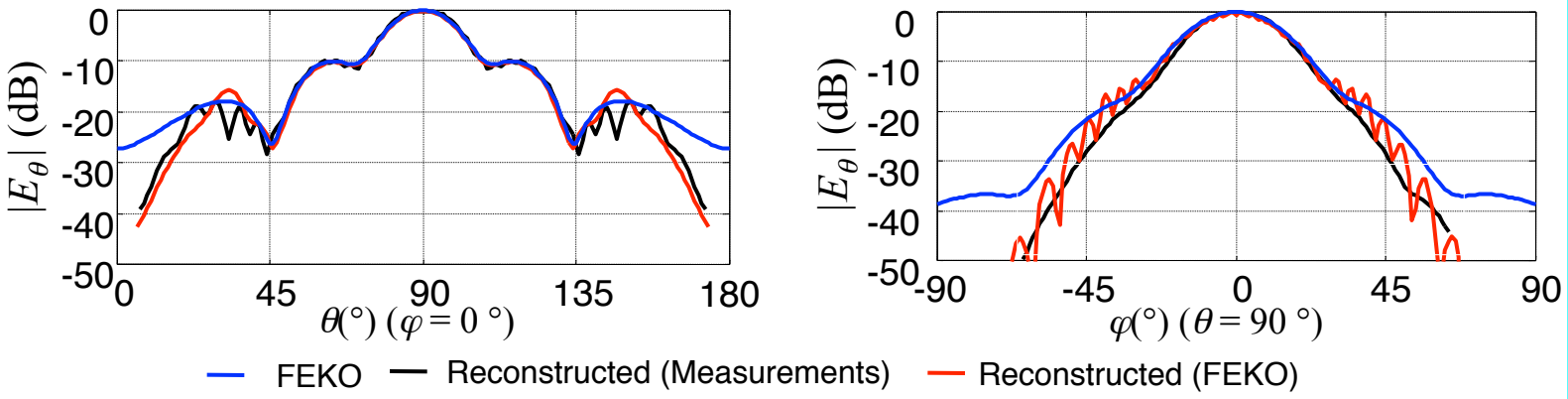


EXPERIMENTAL VALIDATION : f = 8 GHz

✦Validation of reconstructed far field



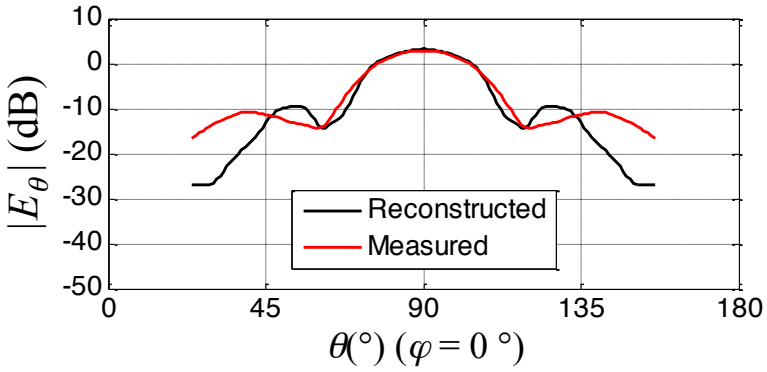
Exact, reconstructed from simulated magnitudes and from measured magnitudes

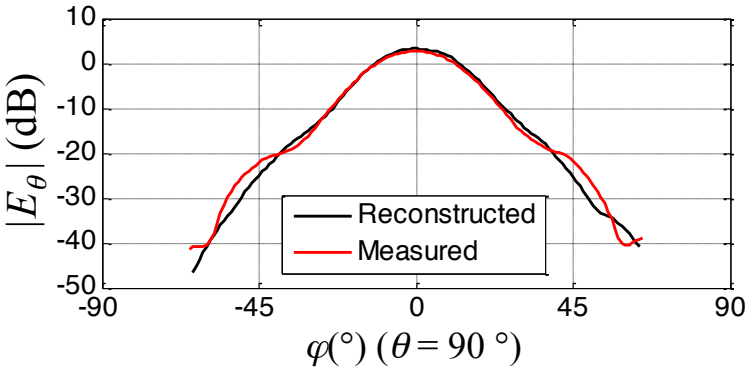


EXPERIMENTAL VALIDATION : f = 2 & 18 GHz

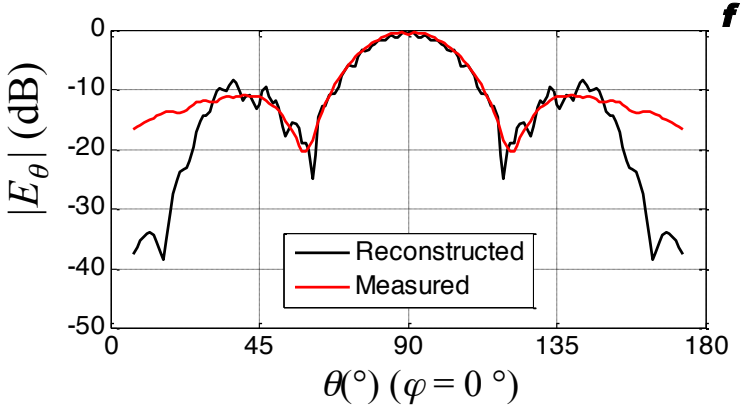
✦Validation of reconstructed far field

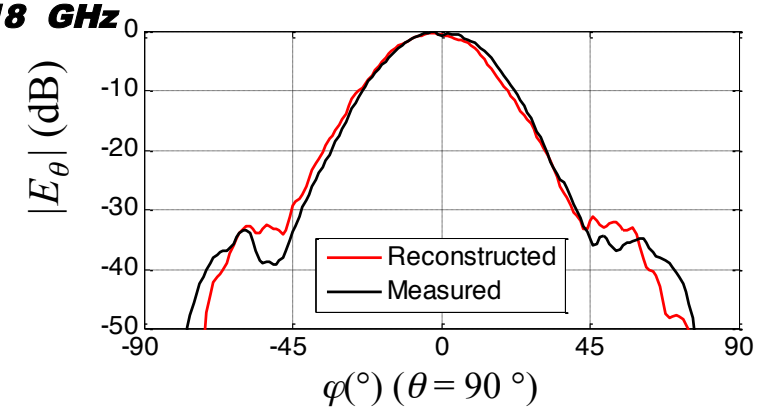
f = 2 GHz





f = 18 GHz





CONCLUSION & FUTURE WORKS

- **Conclusions on the phase reconstruction algorithm**
  - ✓ Validation on numerical and experimental data
  - ✓ Parametric study for optimal use
  - ✓ Wide band validation
- **Future tasks**
  - ✓ Adding information to increase performances
  - ✓ Expanding the parametric study
  - ✓ Towards pulsed sources …